

# Etiology of community-acquired pneumonia in hospitalized patients in Jordan

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## ABSTRACT

**Objective:** To ascertain the causative organisms of community acquired pneumonia (CAP) in Jordanian patients requiring hospital admission.

**Methods:** A prospective study of both adults and children admitted to Princess Basma and Princess Rahma Teaching Hospitals in Irbid, Jordan with a diagnosis of CAP over a 6-month period from April to October 2002.

**Results:** A total of 35 adult patients were admitted with a mean age of 47 years, and 63 children with a mean age of 3 years. A pathogen was isolated from 25 (71%) adults, and from 17 (27%) children, and sputum cultures gave the best diagnostic yield. In adults *Streptococcus pneumoniae* was the most common isolate (26%), followed by *Chlamydia pneumoniae* (23%), *Haemophilus influenzae* (17%), *Mycoplasma pneumoniae* (9%), and *Legionella*

*pneumophila* and *Klebsiella pneumoniae* (6%) each. Seven of the 9 gram negative isolates were from patients with some co morbid illness. While in children, *Chlamydia pneumoniae* was the most common (14%), followed by *Mycoplasma pneumoniae* (6%), and *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Pseudomonas aeruginosa* (3%) each.

**Conclusions:** *Streptococcus pneumoniae* and atypical microorganisms are the most common cause of CAP in previously healthy adults; while in those with associated co morbid illness, gram negative organisms are the likely cause. In children, the overall detection rate of causative organisms was low with atypical microorganisms being the most common.

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Community acquired pneumonia (CAP) is a common reason for hospital admission, both in children and adults, and remains an important cause of morbidity and mortality.<sup>1-3</sup> Antibiotic treatment is started empirically in most cases of CAP before the causative agent is identified, and the choice of antibiotics should be based on the most likely pathogen in each community, although the causative pathogen is not identified in as much as 50% of patients, even with extensive diagnostic testing.<sup>4-8</sup> In the light of lack of previous studies on the etiology of CAP in Jordanian patients, we conducted this prospective

study in both children and adults requiring hospital admission for CAP in the city of Irbid, in the northern part of Jordan, during the period from April to October 2002.

**Methods.** All patients admitted to Princess Rahma Teaching Hospital (PRTH) and Princess Basma Teaching Hospital (PBTH) with a diagnosis of CAP over a 6 month period from April to October 2002 were included in the study. Informed consent was taken from adult patients and from parents in the case of children. Pneumonia was defined as an

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acute respiratory illness associated with radiographic pulmonary shadowing, which was neither present before, nor was due to another known cause. Any patient who was discharged from hospital within the last 2 weeks prior to admission, as well as patients with tuberculosis were excluded from the study.

**Investigations.** Chest radiographs were obtained in all patients prior to admission and were reported by a radiologist. Complete blood count, urea, creatinine, and serum electrolytes were carried out. Sputum samples were taken from all patients who were able to do so, the samples were collected in a sterile wide mouth container and were processed within 30 minutes of collection. Sputum samples were assessed for adequacy on the basis of seeing more than 25 polymorphonuclear leucocytes and less than 10 epithelial cells per low power field. Gram stain and Ziehl Neelsen stain were carried out on adequate samples according to standard methods,<sup>9</sup> and were further cultured for possible pathogens on blood agar (BA), chocolate agar (CA) plates, and MacConkey agar (MA). Both BA and MA were incubated aerobically, whereas CA plates were incubated under 5-10% CO<sub>2</sub> at 37°C for 24 hours. Growing colonies were identified according to standard methods.<sup>10</sup> Blood cultures were obtained from all patients. Three to five milliliters of blood were collected under aseptic technique and added to blood culture bottle containing 25 milliliters of brain heart infusion broth (Oxoid, UK), incubated at 37°C up to 14 days, with daily examination for turbidity, hemolysis, colonies, or gas. Subcultures were carried out from bottles every 2 days on BA, and CA, and plates were incubated at 37°C aerobically (BA) or under 5-10% CO<sub>2</sub> (CA). Growing colonies were identified using standard biochemical methods.<sup>10</sup> In each patient, 2-3 ml of blood was collected in anticoagulant free tubes and allowed to clot at room temperature for 2 hours, then centrifuged at 4000 round per minute for 5 minutes. The serum was separated in 2 ml conical Eppendorf tubes and stored at -20°C until used. Indirect immunofluorescence assay was used to detect IgM antibodies against *Legionella pneumophila* (Vir Cell SL), *Chlamydia pneumoniae* (Euroimmun), and *Mycoplasma pneumoniae* (Linear Chemicals) according to the recommendations of the kit manufacturers (Euroimmune).

**Results.** During the study period from April to October 2002, a total of 101 patients were admitted with a diagnosis of CAP (63 children admitted to PRTH, and 38 adults admitted to PBTH). Three adult patients had positive sputum smears for acid fast bacilli and were excluded from the study. The mean age of pediatric patients was 3 years (range,

1 month-13 years) and the majority of them were males (67%), while the mean age of adult patients was 47 years (range, 15-75) with relatively equal proportions of males and females (males 46%). Comorbidity was found in 21% of the pediatric group, and in 34% of adults, and some had more than one disease. Radiographic changes were of a lobar pattern in 36% of pediatric group and in 43% of adults, while a bronchopneumonia pattern was present in 64% of the pediatric group and in 57% of adults. Previous use of antibiotics was seen in 16% of the pediatric group and in 29% of adults.

**Etiological diagnosis.** A causative organism was detected in 52 specimens. A single organism was the cause of CAP in 32 patients (19 adults and 13 children), and 2 organisms were implicated in 10 patients (6 adults and 4 children), giving a total detection rate of 71% in adults (25 out of 35 patients) and 27% in children (17 out of 63 patients). In adult patients, *Streptococcus pneumoniae* (*S. pneumoniae*) was the most common cause of CAP, it was isolated in 9 patients (26%), followed by *Chlamydia pneumoniae* (*C. pneumoniae*) in 8 patients (23%), *Haemophilus influenzae* (*H. influenzae*) in 6 patients (17%), *Mycoplasma pneumoniae* (*M. pneumoniae*) in 3 patients (9%), *Legionella pneumophila* (*L. pneumophila*) and *Klebsiella pneumoniae* (*K. pneumoniae*) in 2 patients each (6%), and *Pseudomonas aeruginosa* (*P. aeruginosa*) in one patient (3%). Seven out of the 9 gram negative isolates were identified in patients with underlying diseases including chronic obstructive pulmonary disease, diabetes mellitus, and immune suppression. One pathogen was the cause of CAP in 19 adult patients (54%), and again *S. pneumoniae* was the most common cause, being identified in 7 patients (20%), followed by *H. influenzae* in 6 patients (17%), and *C. pneumoniae* in 4 patients (11%), while mixed infections were identified in 6 adult patients (17%), with atypical microorganisms being the most common pathogen involved.

In children, *C. pneumoniae* was the most common cause of CAP, it was identified in 9 patients (14%), all except one were identified in children above 5 years old, followed by *M. pneumoniae* in 4 patients (6%), and *S. pneumoniae*, *H. influenzae*, and *P. aeruginosa* in 2 patients each (3%). All gram-negative microorganisms were isolated from patients with underlying diseases (2 had cystic fibrosis, 2 immune compromised, and one had congenital heart disease). One pathogen was the cause of CAP in 13 children (20%), while mixed infections were identified in 4 patients (6%) with atypical microorganisms being the most common pathogens involved in mixed infections.

Atypical pathogens were detected in 4 of 10 adult patients (40%) who were on antibiotics before admission, and in 7 of 25 patients (28%) who were not on prior antibiotics. On the other hand, bacterial pathogens were detected in 3 of 10 patients (30%) who were on prior antibiotics, and in 16 of 25 patients (64%) who were not on prior antibiotics. However, in children atypical pathogens were detected in 7 of 10 patients (70%) who were on prior antibiotics, and in 3 of 53 patients (6%) who were not on prior antibiotics. While bacterial pathogens were not detected in any child who was on prior antibiotic (0%), and in 8 of 53 patients (17%) who were not on prior antibiotics. All bacteremic infections occurred in patients without prior antibiotic use, except one adult patient had positive blood culture for *S. pneumoniae* with prior antibiotic use. Adequate sputum samples were collected from 22 adults, and only 10 out of 63 children were able to give adequate sputum samples. Etiological diagnosis was made in 18 sputum samples, giving a detection rate of 56%. Serum samples were collected from 86 patients (35 adults and 51 children), and 26 samples were positive (13 adults and 13 children) giving a detection rate of 30% by serology. Blood cultures were also collected from 86 patients (35 adults and 51 children), and only 8 samples were positive (3 adults and 5 children) giving a 9% yield from blood cultures.

**Discussion.** This prospective study was carried out in Jordan to look for the etiology of CAP both in children and adults, who require hospital admission. The causative agent was identified in 71% of adults, and in 27% of children. In adults, the most common pathogens isolated as the sole cause of CAP were *S. pneumoniae*, *H. influenzae*, and *C. pneumoniae*, while mixed infections were identified in 17% of cases with atypical microorganisms being the most common pathogens involved. In children, the detection rate was low, and *C. pneumoniae* was the most common pathogen isolated as the sole cause for pneumonia as well as in mixed infections. Bacterial pathogens were less likely to be diagnosed in those with prior antibiotic use. In our study, the detection rate of the etiological agent in adult patients was comparable to other studies,<sup>5,6,11</sup> while the detection rate in children was low as compared to other studies.<sup>8,12,13</sup> The highest yield for causative agents in our study comes from sputum cultures, followed by serology and blood cultures. The high yield from sputum cultures in our study (56%) is comparable to other studies,<sup>5,6</sup> Viruses are a major cause of pneumonia in young children,<sup>8,12,13</sup> being diagnosed in 62% of hospitalized children with CAP.<sup>13</sup> The low detection rate in children in our study,

could be explained by the small number of children who could give adequate sputum samples, as well as the lack of virological tests in our study. Rapid diagnostic techniques such as polymerase chain reaction (PCR) for various microorganisms should increase the diagnostic rate in children with CAP.<sup>14,15</sup> The low yield of blood cultures in our study (9%) conforms to previous observations,<sup>8,11</sup> which may be because of low sensitivity, or preadmission antibiotic use. However, a retrospective study from Saudi Arabia,<sup>5</sup> showed that blood cultures were positive in 19% of patients, but in that study prior antibiotic use was presumably low, although it was not ascertained. Mixed infections were encountered in both adults and children with atypical microorganisms particularly *C. pneumoniae* and *M. pneumoniae* being the most common co-pathogen. This is in agreement with other studies,<sup>6,11-13</sup> although viruses, when tested for, were the most common pathogen in such mixed infections.<sup>11,13</sup> The most interesting finding in our study is the high rate of *C. pneumoniae* infection, both in children and adults. This could be related to the nature of this organism, which occurs both in an endemic and epidemic form, and it might be that our study was carried out during an outbreak of this organism. However, population based studies in children with CAP found similar results,<sup>12,16</sup> although other workers<sup>8,13</sup> found a low incidence of *C. pneumoniae* in children with CAP requiring hospital admission. In a regional study by Kurashi et al,<sup>5</sup> they did not detect a single case of *C. pneumoniae* infection in adults admitted with CAP, but their study was retrospective, and they tested only 11 patients out of 567 patients for *C. pneumoniae*. Other studies found similarly high incidence rates of *C. pneumoniae*,<sup>11,17</sup> and it was the second most common pathogen in adult patients admitted with CAP.<sup>11</sup> In our study, *C. pneumoniae* was found frequently in mixed infections, as also reported in other studies,<sup>18,19</sup> and this could be related to their effect on ciliated epithelial cells,<sup>20</sup> which might promote other bacterial infections. It is important to emphasize the limitations of our study. Firstly, serologic tests give indirect evidence of the disease, and probably the high rate of atypical pathogens in our study should be considered with care. Secondly, the study period was limited to 6 months from April to October, and it is known that certain types of organisms causing CAP are more prevalent in certain times of the year, so a whole year study is warranted together with the use of PCR techniques to detect various microorganisms including viruses. Overall, this study showed that *S. pneumoniae*, together with *C. pneumoniae* and *M. pneumoniae*, are the most common pathogens to cause CAP in previously

healthy individuals including children and adults, and empirical treatment in such cases should include antibiotics with coverage to such microorganisms, while a gram negative coverage has to be considered in patients with underlying lung diseases or those who are immunocompromised.

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